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This report covers the design and production of a video tape for testing low bit rate motion codecs. It is part of a program for comparative evaluation of motion codecs used for teleconferencing at a wide range of bit rates. The specific purpose of the tape is to provide pictorial material which may occur during both government and commercial teleconferences and related applications which simultaneously stress the capabilities of each codec sufficiently so that differences in performance will become apparent.

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DEVELOPMENT OF A VIDEO TAPE TO TEST VIDEO CODECS OPERATING AT 64KBPS

FEBRUARY 1989

OFFICE OF THE MANAGER
NATIONAL COMMUNICATIONS SYSTEM
WASHINGTON, D.C. 20305

NCS TECHNICAL INFORMATION BULLETIN 89-2

DEVELOPMENT OF A VIDEO TAPE TO TEST VIDEO CODECS OPERATING AT 64 KBPS

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FOREWORD

Among the responsibilities assigned to the Office of the Manager, National Communications System, is the management of the Federal Telecommunication Standards Program. Under this program, the NCS, with the assistance of the Federal Telecommunication Standards Committee identifies, develops, and coordinates proposed Federal Standards which either contribute to the interoperability of functionally similar Federal telecommunication systems or to the achievement of a compatible and efficient interface between computer and telecommunication systems. In developing and coordinating these standards, a considerable amount of effort is expended in initiating and pursuing joint standards development efforts with appropriate technical committees of the Electronics Industries Association, the American National Standards Institute, the International Organization for Standardization, and the International Telegraph and Telephone Consultative Committee of the International Telecommunication Union. This Technical Information Bulletin presents an overview of an effort which is contributing to the development of compatible Federal, national, and international standards in the area of Video Teleconferencing. It has been prepared to inform interested Federal activities of the progress of these efforts. Any comments, inputs or statements of requirements which could assist in the advancement of this work are welcome and should be addressed to:

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DEVELOPMENT OF A VIDEO TAPE TO TEST VIDEO CODECS OPERATING AT 64 KBPS FINAL REPORT

February, 1989

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SECTION 1 - INTRODUCTION AND SUMMARY

This document summarizes work performed by Delta Information Systems, Inc., for the National Communications System, Office of Technology and Standards. This office is responsible for the management of the Federal Telecommunications Standards Program, which develops telecommunications standards, whose use is mandatory for all Federal departments and agencies. This study was performed under task order number 87-007 of contract number DCA100-87-C-0078.

This report covers the design and production of a video tape for testing low bit rate motion codecs. It is part of a program for comparative evaluation of motion codecs used for teleconferencing at a wide range of bit rates. The specific purpose of the tape is to provide pictorial material which may occur during both government and commercial teleconferences and related applications which simultaneously stresses the capabilities of each codec sufficiently so that differences in performance will become apparent. The choice of material must lead to a completely impartial evaluation without favoring any particular algorithm, but should be constrained by the limitations of low bit rate encoding

and transmission.

Section 2 of this report describes the relevant background material which was reviewed before starting the tape design. Subsequently, the results of a survey of existing and future applications by U.S. Government and commercial users are given in Section 3. Section 4 describes the selection and organization of the material that was included in the test tape, resulting in the final edited scenario given in Section 5. A brief conclusion is presented in Section 6.

SECTION 2 - AVAILABLE BACKGROUND MATERIAL

2.1 Previous NCS Programs

The most closely related previous program is the Development of a Video Tape to Test Teleconferencing Codecs as documented in NCS Technical Information Bulletin Number 85-2 dated August 23, 1985. The purpose of this tape was to subjectively test, evaluate and rank the performance of codecs operating at 1.5 Mbps as documented in NCS Technical Information Bulletin Number 85-1, published on the same date. The results showed that the program was successful in proving that the tape was fully suitable for its intended purpose. Therefore, it stands to reason that a very similar approach should be followed in the preparation of a test tape specifically suited to testing state-of-the-art codecs operating at low bit rates. The many advances in codec technology make it possible to use much of the material previously prepared for higher bit rate codecs.

2.2 Codec Evaluation for INTELSAT

The results of this program are documented in a "Final Report -- Digital TV Codec Evaluation for INTELSAT AT ICDSC-7", dated August 1986. Its purpose was not to rank the performance of different codecs but to establish the acceptability of codecs operating at various bit rates for specific applications. The bit rates covered the range of 56 Kbps to 2.048 Mbps. The test tape was mainly edited from previously recorded material re-arranged for

the purpose of these tests. Subjective evaluations by a large number of participants of the ICDSC-7 (7th International Conference on Digital Satellite Communications) conference produced consistent and useful results.

One important fact came to light through complaints by manufacturers of low bit rate codecs. Some scenes of the test tape end almost immediately after a piece of graphic material has been adjusted to the desired position and viewing angle, not allowing enough time to evaluate the quality of the still picture. Different codecs have different settling times which is an important performance feature. All subsequently produced and edited test tapes provide sufficient motionless viewing time of all graphic material.

SECTION 3 - APPLICATIONS SURVEY

3.1 General

There are several broad categories of application of low rate digital codecs operating at approximately 64 Kbps up to 256 Kbps. The first which has come under close scrutiny by international and national committees is videophone, providing audio and video connection between individuals over available telephone facilities. A logical expansion of this application is a limited teleconference in which faithful rendition of motion and fine details of the participants is secondary to the presentation of graphic information. Other applications either emphasize, or are limited to, the transmission of graphic and still pictorial material Examples of the latter are general graphic data exchange and distance learning. DIS personnel has performed the survey of all these applications by participating in the meetings of the CCITT Study Group XV Specialists Group on Coding for Visual Telephony, and by attending the Applications Seminar on Video Teleconferencing for DoD, Civil Agencies, and Defence/Aerospace Contractors, presented April 11 to 13, 1988 in Bethesda, MD.

3.2 Videophone

At one of the meetings of the CCITT Specialists Group it was agreed that one of the key applications of m x 56/64 Kbit/s video coding "is videophone which is characterized by head-and- shoulders pictures shown on a monitor that is typically smaller than 12

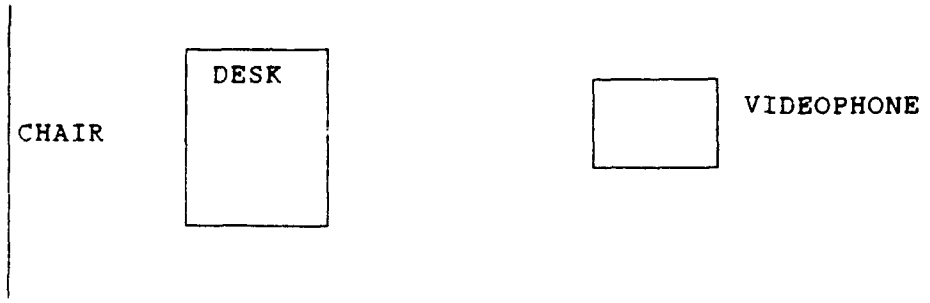
inches". In the process of preparing candidate video scenes for simulation activities by the Specialists Group Delta Information Systems (DIS) developed a range of potential videophone images which cover a variety of conditions. Their specific purpose is to

1) show alternative locations of videophone equipment in the office.
2) produce a video tape containing 9 brief scenes which cover a wide range of videophone locations and camera fields of view
3) stimulate thought to be sure that the m x 56/6 Kbit/s codec is designed for the most representative videophone scene(s).

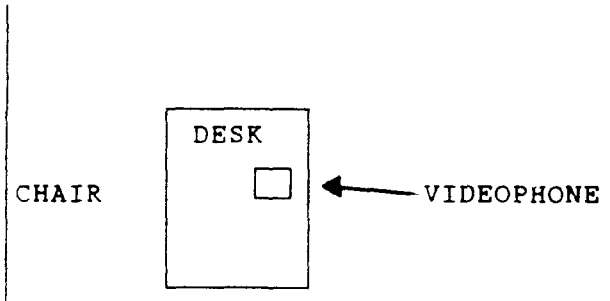
In view of the rapid development of visual communications in the Government and business world, it is necessary to consider various office sizes and arrangements. It is assumed that in most cases the camera and monitor will be co-located to form a single unit. Three potential office layouts are shown on Figure 3-1.

The layout shown on top is primarily applicable to a rather spacious executive office. There is plenty of room in front of the desk for a camera and mid-size monitor, either in a fixed location or on a movable pedestal. Normally, a fixed focal length lens will be adequate though in a few exceptional cases a remotely controlled zoom lens may be justified.

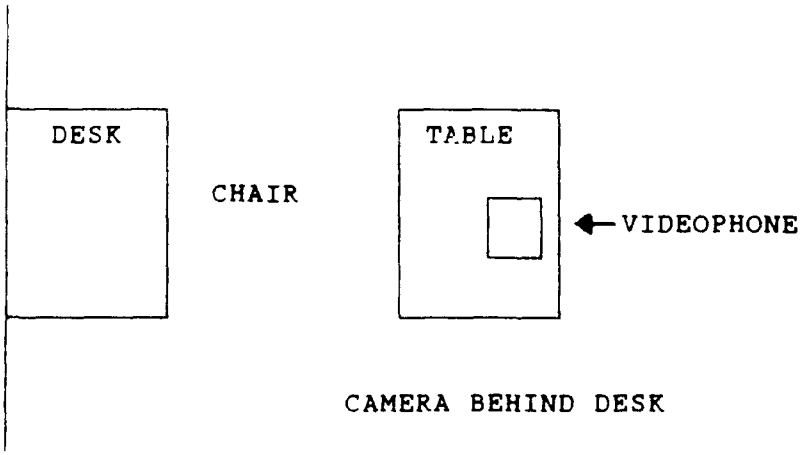
The middle layout shows the camera videophone terminal located directly on the desk. This setup is inherently less



CAMERA IN FRONT OF DESK



CAMERA ON DESK



CAMERA BEHIND DESK

FIGURE 3-1 - VIDEOPHONE OFFICE LAYOUTS

flexible from the standpoint of field of view. This layout has the advantage of being rather universal, independent of the office layout.

The bottom of Figure 3-1 shows a different but frequently found office arrangement. The desk is placed directly against the wall and a work table is located behind the office occupant. The videophone terminal is mounted on this table. When using the videophone the office occupant turns around exactly as if he was talking to a person sitting at his table. It is unlikely that anything but a fixed focal length lens will be used in this setup.

An important parameter is the field of view covered by the camera. The requirements for this may differ rather widely for various applications, from a limited head and shoulders view of a person to coverage of the whole desk top. The customary descriptions of these views, "close-up" and "wide angle", are much too indefinite and a numerical definition of the angles of the width and/or height of the field of view is rather intangible and non-descriptive from a practical point of view. Therefore, the practical parameter used here is to express the picture width in number of shoulder widths of the person shown. Though this is an estimate rather than an exact measurement it defines the field of view in a straightforward manner directly related to the videophone application.

The tape consists of 9 scenes, covering the three different layouts described above. Table 3-1 summarizes the key parameters for each scene. Different combinations of the field of view and

type of action are provided. An additional parameter listed is the visibility of the desk top which can be important in the discussion of printed or written material.

SCENE NO.	CAMERA LOCATION	ACTION	FIELD OF VIEW (SHOULDER WIDTHS)	DESK TOP VISIBILITY
1	FRONT OF DESK	TELEPHONE CALL	5	MOST
2	FRONT OF DESK	EQUIPMENT DEMONSTRATION	3	LESS THAN HALF
3	FRONT OF DESK	TELEPHONE CALL	2	LITTLE
4	FRONT OF DESK	MAGAZINE ARTICLE DISCUSSION	1.2	NONE
5	ON DESK	EQUIPMENT DEMONSTRATION	1.5	NONE
6	ON DESK	SALES TALK	1	NONE
7	BEHIND DESK	EQUIPMENT DEMONSTRATION	4	ALL
8	BEHIND DESK	EQUIPMENT DEMONSTRATION	3	MOST
9	BEHIND DESK	EQUIPMENT DEMONSTRATION	1.3	ALMOST NONE

TABLE 3-1 - VIDEOPHONE SCENES TAPE CONTENTS

The video tape was submitted to meetings of the CCITT

Specialist Group and of the U.S. Telecommunication Standards Committee T1Q1 on Performance. Thus both international and U.S. experts were involved in the evolution and critique of its contents. A questionnaire was submitted to all participants and their responses were analyzed, summarized and averaged as shown on Table 3-2, Sheets 1 to 4. A total of 37 responses was obtained, however, not all participants answered every question.

This analysis shows that, even though low bit rate video terminals will predominantly be used by a single person, their application for teleconferences with up to 6 participants will also be significant. The use of graphics will be very important. Almost half of the graphics applications will prefer a resolution higher than the one obtainable in a basic videophone terminal. This fact has been recognized by a number of codec manufacturers who provide an optional freeze frame mode featuring improved resolution.

3.3 U.S. Government and Related Users

Many U.S. Government Agencies are presently using live video teleconferencing, generally at 1.544 Mbps which require costly communication facilities. The recent introduction of Integrated Service Digital Network) ISDN, providing relatively low cost common user facilities at 64 Kbps, has made it very desireable to re-examine requirements to determine to what extent full motion capability may be sacrificed in favor of considerably reduced cost.

QUESTIONNAIRE FOR THE

56/64KB/SEC VIDEOPHONE APPLICATION

A. Video Tape Questions

1. Assuming only one person is viewed by the camera in the office, which office layout do you think will be the primary 56/64Kb/sec application; secondary use, etc. Rank 1, 2, 3 in spaces provided below.

Behind desk	2	No responses for Primary Videophone Application
Front of desk	14	
On desk	21	
Other	---	

If you marked "other," explain your layout below.

2. Assuming the field of view of the videophone terminal is fixed, and the unit is viewing one person, what do you think the field of view will be in shoulder-widths.

1.9 shoulder-widths

TABLE 3-2: SHEET 1

3. Which of the nine scenes in the video tape do you think best represents the videcphone application?

Scene _____

Do you think this scene well represents the videophone application?

Yes _____

No _____

No. Persons Preferring Scene	Scene No.	Camera Location (Desk)	Field of View (Shoulder Width)
6	2	FRONT	3
11	3	FRONT	2
11	5	ON	1.5
2	7	BEHIND	4
2	9	BEHIND	1.3

B. General Questions

1. What percentage of the time do you think a videophone terminal in the office will be viewing one person as opposed to multiple persons.

72 % one person

2. The table below defines four possible applications for the use of the 64Kbps codec. How do you think these applications will be distributed on a % basis. (early 1990's)

TABLE 3-2: SHEET 2

POTENTIAL 64KB/S APPLICATIONS

Purpose		Terminal Location	Typical No Persons per Site	Interactive (I) Broadcast (B)
Videophone		Office	1-2	I
Conference e.g. problem solving		Conference Room	2-6	I
Education	Source	Office/Conf. Room	1	B
	Destination	Classroom	Many	
Videophone		Home	1	I

Videophone Office	40
Conference	30
Education	16
Videophone Home	8
Other	6
Total	100%

TABLE 3-2: SHEET 3

3. In those cases where multiple persons are viewed in the conference room what will the % distribution be for the various number of persons viewed.

2	45 %
3	29 %
4-5	20 %
6 or more	6 %
Total	100 %

4. What percentage of the videophone calls in the office will employ graphics?

45 %

In those calls where graphics are used what percentage will use the basic videophone resolution as opposed to a separate graphics source with higher resolution?

55 % basic videophone resolution

TABLE 3-2: SHEET 4

The Defense Commercial Telecommunications Network (DCTN) presently provides the mainstay of military communications including video teleconferencing. At present this service is mainly handled over T-1 circuits with available codecs but changes are imminent in the near future. Plans are to adopt the N x 384 Kbps and later the N x 64 Kbps standards for video transmission, providing near full and limited motion live video and high resolution graphics.

The White House Communications Agency (WHCA) must provide service for the President anywhere in the world. This extreme portability constrains the performance of the system. A new system will be needed. WHCA personnel are closely monitoring new developments, focusing on performance, reliability, size and cost. In the distant future, on the horizon of video teleconferencing, they assume continued progression with down sizing of the systems to a personal portable carry size. An individual would be able to carry the capability of video teleconferencing with him in his briefcase as he currently carries his calculator and cellular telephone. Merging this capability with computer technology, image processing, document scanning and other telecommunications disciplines would provide for tremendous capabilities both in the office and while traveling. Integral with the device (which would include embedded encryption) would be a video capability, initially freeze-frame, but eventually incorporating slow or even full motion video with audio, all encrypted. A printer built into the desktop unit would be capable of text and even video printouts of a

captured frame of the video.

The Naval Supply Systems Command sees a need for video teleconferencing to implement their logistics modernization program in the face of increased demands, reduced manpower and tighter budgets. At present they envision three-way full motion conferences using 768 Kbps codecs, augmented by a freeze-frame high resolution graphics capability. They emphasize interoperability with other systems and connections via existing facilities, such as DCTN (Defense Communication Teleconferencing Network), AT&T, and the Sprint Meeting Channel. Low data rate video is presently not anticipated but may be used in the future.

The Air Force Logistics Command (AFLC) performs similar functions and therefore has fairly similar requirements. They stress the use of audio/visual aids and special purpose cameras, and the saving of manpower and money by reducing travel. In face-to-face briefings personal recognition and body language are important. High resolution graphics are needed. The existing AFLC system is good but requires updating. It is not clear if that may include a reduction in data rates.

The Naval Underwater Systems Center has an existing system between Newport, RI, New London, CT, and Crystal City VA, operating at 1,544 Mbps. Two live displays plus graphics are used at each terminal. System performance is very satisfactory and expansion to other sites is anticipated. There are no present plans for the use of low data rates but such a development cannot be ruled out.

The Naval Air Systems Command (NASC) simultaneously uses

motion color video, high resolution graphics, voice and data. As much as possible, they integrate their requirements with DoD and the other services. All use DCTN, generally with security added. In widespread aircraft and weapons tests, video conferencing is vital for efficient coordination and cost saving. NASC is aware of possible future savings by using low rate video codecs.

The National Security Agency (NSA), though not a primary user of video teleconferencing, nevertheless is deeply involved because of its responsibility for the security aspect. It is concerned with the overall equipment configuration of codec-Key Generator-modem and the operational management, distribution and protection of the encryption keys. KG's are available for the whole range of data rates used in video teleconferencing but significant cost savings can be obtained if the maximum rate is 64Kbps. It therefore stands to reason that future secure video teleconferences will be limited to this rate as much as feasible.

Many large scale defense contractors have recognized the advantages of video teleconferencing during the last few years. Increasing work loads and complexity of military programs have hastened this development. The geographical spread of company locations, customers and suppliers, and the need for short reaction times make any other solution at least very costly if not completely impractical. There will be some large conferences but the mainstay of the defense contractor video system will be the desk top terminal, operating at a data rate of not more than 112 Kbps. A high resolution graphics capability is essential. A

multipoint interactive network implemented with fiberoptic cabling and satellite links will ultimately evolve.

3.4 Distance Learning

Dissemination of information is one of the fastest growing applications of videoteleconferencing technology. Though there are some cases where a full-fledged teleconfrerencing setup is desireable such as between several college campuses, the most likely system configuration is the broadcast type or point-to-multipoint transmission. It is obvious that a satellite system is ideally suitable for this application but fixed land lines (microwave or fiber optics) or Public Broadcast Service (PBS) channels may be used. One way video transmission is normally sufficient but interactive audio is essential or at least highly desireable.

Instructional material such as still or moving graphics and charts and computer generated displays form the mainstay of the visual information to be transmitted. However, it also is vital to be able to show the picture of the instructor talking, writing, drawing and erasing on a board to create the psychologically important feeling of direct presence. If economically feasible, the program origination facility should have a very flexible setup employing several cameras, zoom capability, high resolution still graphics and high quality flexible audio.

Following are a few typical example of the many possible applications of distance learning. One common feature of most

programs is the limited availability of funding. Therefore it is necessary to minimize the cost of transmission facilities which makes the use of low data rate video codecs mandatory. This imposes no serious constraint since transmission of fast motion is not required to achieve the objectives of distance learning.

For several years the Federal Bureau of Investigation has been instructing local police departments in advanced law enforcement techniques, using a large variety of training materials. This service is provided without cost to the receiving department but constrained by the availability of local distribution facilities. Since cable distribution is generally too limited, satellite services appear to be the most likely solution. Even if the police department does not have its own satellite receiver, another public institution such as a high school may be able to make its facilities available when needed.

The Federal Emergency Management Agency (FEMA) has been one of the first organizations to use low data rate video conferencing for training the population in handling natural and man-made emergencies. Not surprising, the first use of this medium was in Alaska where it was propagated by means of satellite circuits. Based on experience obtained there, FEMA developed its own Emergency Education Network (EENET) as an outreach tool. EENET has become a national project combining federal, state and local government resources and its operation can easily mean the difference between life and death. Fully interactive video and audio with switching is generally necessary to provide full

information to all parties. In spite of this sophistication the use of low data rate equipment has generally made it possible to keep the operating costs of EENET relatively low.

The Army Logistics Management Center (ALMC) uses a formal remote teaching system with one-way satellite-borne video and interactive audio. The teaching material includes live presentations, video tapes and computer graphics. Most graphic material is prepared at a central office and stored on a floppy disk for later dissemination and display. The cost of this system is only a fraction of what it would be if all students had to be brought to attend classes at one or several teaching centers.

SECTION 4 - TAPE PREPARATION

4.1 General

The preparation of the test tape for subjective testing of 64Kbps video codecs was mainly based on the previous experience described in Section 2 of this report. It is understood that the number of 64 Kbps is not an absolute limit but only an approximate guideline. A large portion of the material prepared for this program will also be usable at much higher data rates. Since the test tape is to be used for subjective comparison of equipments by a jury, the fatigue factor must be taken into account. The tape must be as all-encompassing as possible without becoming too long. A total of about 30 minutes for each test is considered the maximum which is permissible. Originally it was assumed that consecutive sequences should always be dissimilar but there are other factors to be considered. Grouping of various types of scenes is often desireable. For instance, a number of codecs have a high definition freeze frame mode usable for still graphics. Since it is not practical to switch codec modes between test sequences all still graphics should be presented in one group.

4.2 Tape Contents

Based on application requirements and the above mentioned factors, there are three distinct categories of test material which should be incorporated in the tape. They are:

- Still Graphics

- o Motion Graphics
- o Limited Motion Conference Scenes

Still graphics consist of scenes requiring good resolution and color fidelity for proper rendition. Their main purpose is testing the freeze-frame mode of a codec but they are equally usable in the conventional motion mode. Motion graphics have similar material but in addition contain pointing and writing, camera zooming and moving of the observed material. Limited motion conference scenes show one up to six persons at a desk or in a conference type environment.

4.3. Available Material

All previously prepared material was carefully reviewed before selection for inclusion in the new tape. Criteria for inclusion were excellent picture quality and past experience indicating that the material is challenging to the performance capability of most codecs. In the area of still graphics this was mainly colored lettering on various backgrounds and standard Society of Motion Picture and Television Engineers (SMPTE) test pictures. A number of scenes containing pictorial material with motion and zooming were very useful after some modification to provide a steady picture for at least three seconds after all adjustments were made. This allows enough settling time for all low bit rate codecs. Finally, conference scenes with limited motion were selected. These scenes ranged from head and shoulder views of a single person to wider angle pictures of one up to six persons, all in accordance

with the previously performed applications survey.

4.4 New Material

Preparation of additional material was deemed necessary in all of the three categories addressed in paragraph 4.2 to produce a meaningful up-to-date test tape. This included scenes similar to those available but of improved quality and some different type scenes to fully implement the requirements obtained in the applications survey. It has become clear that graphics of all descriptions will form a large part of the material used by low bit rate codecs. Therefore, a large portion of the new material is devoted to graphics requiring good resolution and color reproduction, such as charts, maps and diagrams. Motion is added in many cases in the form of pointing with either pointer or finger, marking or correcting with colored pens, in addition to material movement and camera zooming.

In the area of live teleconferencing material, several of the videophone scenes described previously in paragraph 3.2 were added. These scenes were the ones deemed most typical in the applications survey. It must be noted that the motion of the person at the desk sometimes is more lively than in other scenes with limited motion, but there is no reason to exert undue restraint. It is the main purpose of the test tape to stress the capabilities of each codec at least to its performance limit and
such scenes make sure that this objective will be reached.

SECTION 5 - TAPE EDITING

5.1 General Layout

The video codec test tape produced in this program is a portion of a family of tapes applicable to the testing of all video codecs. Therefore it is divided into three distinct parts two of which are equally useful for low and high bit rate codecs. The lengths of each part are in approximate proportion to the amount of each type of material when averaged over the anticipated usage of low bit rate codecs.

The layout of each part of the test tape follows the pattern of the previous tape which has proven to be successful. Since the tape is used for side-by-side comparative subjective evaluation, a 10 second long scoring interval is inserted following each sequence. Similar sequences are never consecutive, however, in Part A (Still Graphics) each sequence consists of at least 2 pictures of the same general type since a viewing time of 10 seconds is sufficient for a still picture. Available and new material are intermixed. Two features of the previously produced test tape have been omitted because their limited usefulness did not justify the resulting increased tape length. It had been assumed that differences in monitors might influence the evaluation. Therefore, some test sequences were repeated and monitors interchanged during the test. The results showed no significant effect caused by monitor performance, thus this feature could be safely eliminated.

A special sequence had previously been repeated three times following an extended interval at the end of the tape. This was done to make it possible to artificially insert three different known amounts of bit errors into the transmitted data stream and to evaluate their effect. This feature is very useful for expert codec evaluation but it is not necessary to insert special test sequences. Any portion of the tape can be used for this purpose, as a matter of fact, for a thorough investigation it may be desireable to study the influence of errors on different types of pictorial material.

A new feature of the videophone scenes included in Part C of the test tape is the presence of audio. Experience has shown that in any teleconference the audio performance is very important and often presents a major problem. However, the audio on the test tape is not intended to test audio system performance since subjective "side-by-side" comparison of two audio signals is not possible. Conventional objective test methods would have to be used. Audio has been included because of its potential influence on video. Since at low codec bit rates a considerable percentage of the available bits must be devoted to audio, the efficiency of the audio encoding technique will have a noticeable effect on video performance.

5.2 Final Edited Scenario

The final tape scenario is presented on Tables 5-1 to 5-3. The source of most material is Center City Video (CCV), with still graphics originating either in the studio or in electronic equipment.

The approximate total test sequence durations are as follows: Part A - 4 minutes, Part B - 8 minutes, Part C - 9 minutes. The addition of scoring intervals and titles brings the overall length of all three parts of just under 30 minutes which is in accordance with the original objective.

TABLE 5 - 1

VIDEO CODEC TEST TAPE PART A: STILL GRAPHICS

TAPE SCENARIO

Sequ. No.	Source	Subject Matter	CONTENTS: Lettering	Diagram	Pictorial	Mono	Color	Duration (Sec.)
1	CCV-E	Colored Lettering on	X				X	20
2	CCV-S	Circuit Diagram & Board Layout		X		X	X	20
3	DCA	Colored Lettering - Various Colors & Sizes	X				X	30
4	CCV-S	Block Diagram & Map		X			X	20
5	CCV-E	Colored Lettering on Yellow & Magenta	X				X	20
6	CCV-S	Data Transmission & Vegetables			X		X	20
7	DCA	Print Samples on White & Black	X			X		20
8	CCV-S	Cockpit Panel & Viewgraph			X		X	20
9	CCV-E	Colored Lettering on Green & Red	X				X	20
10	CCV-S	Typed Material - 2 Parts	X			X		20
11	CCV-E	Colored Lettering on	X				X	20
12	CCV-S	SMPTE Slides			X		X	20

CCV-E = Center City Video-Electronic
CCV-S = Center City Video-Studio

TABLE 5 - 2

VIDEO CODEC TEST TAPE PART B: MOTION GRAPHICS

TAPE SCENARIO

Sequ. No.	Source	Subject Matter	CONTENTS			MOTION			Duration (Sec.)
			Diagram	Pictorial Material	Moving	Zoom	Pointing	Drawing	
1	CCV	Circuit Diagram	X			X	X		35
2	CCV	Wine Bottles & Cockpit Panel		X			X		30
3	ISACOMM	Commerce Bank Poster		X	X	X			20
4	CCV	Board Layout	X			X	X	X	31
5	CCV	Activity Diagram	X			X	X	X	30
6	ISACOMM	Grand House Poster		X	X	X			27
7	CCV	Map	X		X		X	X	35
8	CCV	Speech Diagram	X		X		X	X	40
10	CCV	Circuit Diagram Corrections	X				X	X	15
11	CCV	Entropy Curve	X					X	38
12	ISACOMM	Drawing on Pad	X		X			X	40
13	CCV	Inspection Report Forms	X			X	X	X	38
14	CCV	Data Transmission Poster		X		X			20
15	ISACOMM	Bar Graph	X		X	X			14
16	CCV	Organization Chart	X		X	X	X		35

ISACOMM = ISA Communications Services, Inc.

TABLE 5 - 3

VIDEO CODEC TEST TAPE PART C: LIMITED MOTION

TAPE SCENARIO

Sequ. No.	Source	Subject Matter	No. of People	Equ.	Material Handled Phone	Papers	Marker	Camera Pan	Motion Zoom	Duration (Sec.)
1	CCV	Announcer	1							20
2	CCV	Equipment Demo at Desk	1	X						51
3	CCV	"Miss America"	1							15
4	CCV	Phone Call	1		X	X				55
5	ISACOMM	Introduction of 6 People	6 X 1					X		25
6	CCV	Magazine Article	1			X				51
7	CCV	Phone Call	1			X				12
8	CCV	Equipment Demo	1	X	X					55
10	CCV	Equipment Demo at Desk	1	X		X				80
11	CCV	Printed Board Demo	1	X				X	X	30
12	CCV	2 Groups of 3 People	2 x 3			X				30
13	CCV	Man Sitting	1							15
14	PMS	3 Groups of 2 People	3 x 2			X				43
15	SBS	2 Groups of 3 People	2 X 3							30
16	ISACOMM	6 People	6		X					15